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Captains Burton and Speke have done; and I repeat that they have confirmed the important observations of Livingstone—that the coast range that they traversed is much of the same height and composition as that which he traversed, and that like him they found in the interior that great watery plateau, the existence of which he demonstrated.*

In concluding the business of this evening, I may announce that I no longer have any hesitation in addressing my associates as *Fellows* of the Royal Geographical Society. For, in consequence of the application which I made, by the authority of the Council, Her Majesty the Queen has been graciously pleased to grant us Her Charter, and the Royal Geographical Society is now, therefore, placed on the same footing as the older scientific bodies of the country.

Sixth Meeting, February 14th, 1859.

SIR RODERICK I. MURCHISON, PRESIDENT, in the Chair.

PRESENTATIONS.—*The Duke of Wellington; Captain E. M. Jones; Alderman Botterill, of Leeds; and T. H. Alsager, Joseph Mayer, J. Miland, M. H. Pasteur, L. E. R. Rees, W. C. Thomson, Arthur Vesey, and Theodore Walrond, Esqrs., were presented upon their election.*

ELECTIONS.—*Captain Andrew Clarke, R.E.; Lieut.-Colonel William Pottinger; Captain Louis Tindal, R.N.; Samuel Clarke, C.E.; C. Wentworth Dilke; Anthony L. Fisher, M.D.; and John W. Ogle, M.D., Esqrs., were elected Fellows.*

The Papers read were—

1. *On the "Aurora Borealis" in Greenland.* By J. W. TAYLER, Esq.

Communicated by Sir W. C. TREVELYAN, Bart., F.R.G.S.

THE fame of the Aurora's beauty is well known. Travellers in the Arctic regions have written pages describing its fairy brilliance—how it enlivens the frozen solitudes of the north, and makes kind amends for the lost sun. An extended series of observations of the aurora would doubtless be of great interest and service. The few following observations have been made in Greenland as a small instalment.

The distant glimmer of the aurora, as sometimes seen in our

* The Lake of Ujji lies, according to the route-maps sent by Captains Burton and Speke, between the meridians of $26\frac{1}{2}^{\circ}$ and 28° E. long. Its breadth, where crossed between Kabogo and Kasenge, is about 23 miles. From this, crossing to Uvira, near its north end, is 135 miles; the entire lake being 330 miles in length, between latitudes $3^{\circ} 10'$ and $8^{\circ} 30'$ S., and is there made to be about 700 miles from the eastern coast of Africa. Lake Ukerewe, south end, is estimated to be in about latitude $2^{\circ} 40'$ S., longitude $31^{\circ} 30'$. But the observations for longitude, made by Captain Speke at Ujji, on the E. shore of the lake, which have since been roughly computed by Mr. George, place it in longitude $30^{\circ} 23'$ E. Should this position prove to be correct, the distance of the lake from the coast will be only 520 miles.—A. F.

northern horizon, can give no idea of its appearance in the Arctic regions, where for hours continuously the whole heavens from horizon to horizon is brilliantly illuminated with bands, rays, and clouds of luminous matter, waving, darting, and flickering its rays to and fro, and changing its hues from a faint phosphorescent gleam to golden, green, and rose—neither do any of the sketches I have hitherto seen give its true appearance, and are mostly confined to views of it when hardly above the horizon.

I have observed it most frequently over the zenith, and therefrom half-way down to the horizon, the latter having been hid from my view by mountains varying in distance from 1 to 10 miles; the height and distance of these being pretty accurately known, have served as some guide in estimating the extent, height, and speed of motion of the aurora, the latter hereafter described as “Auroral motion.”

The aurora, as it has appeared at Arksut, lat. $61^{\circ} 14' N.$, long. $48^{\circ} 10'$, has been of the following description:—

Long streams of light or luminous matter travelling at times with currents of air, but having within itself independent motions, such as—

1. Shooting rays downwards, never visibly reaching the earth or even extending long below the main body.

2. Rolling horizontally and doubling itself up in waves, precisely as if a long fringed ribbon were held at both extremities, edges up and down, and a waving and serpentine motion communicated to it.

3. Parts brightening by doubling of the band; becoming so opaque that stars of the first magnitude cannot be seen through it.

4. Rapid and changeable motion to and fro, with and against the current of air.

5. Parts of the aurora, without travelling elsewhere, gradually disappearing, and again becoming apparent in the same place without having visibly come from the main body.

6. Bands forming circles and spirals, and rarely into hemispheres, like an enormous parachute over the zenith, with rays projecting all round towards the earth.

The aurora, or its downward rays, do not appear to be attracted or influenced by high mountains, or icebergs, or water, appearing equally over them all, although the long projecting rays shooting downwards would seem to indicate attraction; but this action is not increased when passing over high mountains.

Fitful and changeable as are its motions, one at least appears to be a law, viz. its long bands always occur at or nearly at right angles

with the magnetic poles. These bands almost invariably stretch east and west, or a point or two on each side, never going beyond north-west and south-east or south-west and north-east. This is the case whether the wind be north, south, east, or west. With north and south winds the bands still hold their east and west direction, but are curved to leeward, like any long, yielding body would be if secured at both ends.

With regard to height, extent, and density of the aurora, I have observed as follows:—1st, as to height, about 10 miles west from my place of observation is a mountain 4000 ft. high; I have never seen the aurora or its rays descend below this, and consider it never occurs nearer the earth than between 4000 and 5000 feet, though its altitude is extremely varying, ranging probably from that distance to 10 or more miles in height. The most certain means of estimating the height I found was to observe the effect of the aurora on clouds, and *vice versâ*. I have seen it with the cumuli. When the aurora is above these, the clouds appear as dark masses on it, and hide the light; but when the aurora is under the clouds (that is, nearer the earth than the clouds), the light is reflected by the clouds, and passing through the aurora makes the latter appear more bright in that part; the whole under surface of the cloud is also completely illuminated.

The splendid red and green colours of the aurora are in general only seen when the air is clear and free from vapour and clouds; these colours are not quite so intense as the solar iris, but considerably brighter than the lunar.

Regarding the speed of "auroral" motion (by which I mean the transmission of a wave in the band of light from one part of the band to another, independent of wind), I have remarked on several occasions, when the aurora was partly above and partly below the clouds (which I estimated 10,000 ft. high), that a wave moved from a part of the band, crossing the summit of a mountain to the zenith, in periods of from 4 to 8 seconds, rarely half a minute. The mountain was 4000 ft. high, distant 10 miles, height of eye of observer 24 ft. Supposing the height of the clouds to be judged with moderate accuracy, we could calculate approximately the speed of the "auroral" motion. The wind has no influence on this motion, since the waves of light run equally rapid and frequent to windward or leeward.

By reference to the journal it will be seen when the aurora was above or below the clouds: the temperature, barometer, and weather being given, will enable any one interested in this subject to judge of the nature of the clouds, and estimate nearly their height.

From the foregoing remarks it will be seen that the aurora is confined to certain spaces at no very great altitude, and is not, as has been supposed, a luminous or electric vapour reaching to the earth, and encircling the beholder; that by doubling on itself it becomes more opaque, showing a certain amount of density, inferior however to clouds; that its light is independent, and not a reflection of light from the sun, since its low altitude precludes it; that this vapour or luminous matter has a motion independent of currents of air, and that it has diamagnetic properties; that whatever may be the cause of luminosity, it is composed of matter capable of decomposing rays of light, since the under edge of the aurora exhibits the prismatic colours; that it has within itself a strong cohesion or attraction amongst its parts, holding itself entire in strong winds, and not being scattered abroad like smoke or vapour, yet showing the force of the wind upon it by being curved more or less to leeward.

Since these few facts are insufficient to draw conclusions from, or even to prove definitively the invariableness of any of the appearances I have described, I content myself with the above remarks.

J. W. TAYLER.

Arksut, Greenland, August, 1858.

Explanation of Figures.

- Fig. 1. Appearance of the aurora, when above the clouds.
 „ 2. Ditto, below the clouds.
 „ 3. General aspect of an auroral band.
 „ 4. Aurora, in the form of a parachute, observed only once.

The PRESIDENT.—I beg to return the thanks of the Society to the author of this notice, and also to our friend Sir Walter Trevelyan for having communicated it. As there is no gentleman present who can throw more light upon this subject than that distinguished Arctic explorer, Sir George Back, I call upon him to give us a condensed account of his own observations upon the aurora borealis.

REAR-ADMIRAL SIR GEORGE BACK, Vice-President.—A condensed view of a phenomenon always moving is not an easy thing. I think great credit is due to Mr. Tayler for having given a condensed and graphic description of the aurora borealis, as seen by him at Arksut, in Greenland. I may as well say that Arksut is near Cape Farewell, in lat. $61^{\circ} 14' N.$, long. $48^{\circ} 18' W.$; and as, according to Sir John Franklin and others, the 65^{th} degree of latitude is the most favourable for the observation of the aurora borealis, Mr. Tayler was well situated for that purpose. The aurora generally commences somewhere about $W.$ by $N.$, or a little more northerly, and shoots up in rays or beams, but frequently in arches, extending across the zenith to the opposite horizon; sometimes returning in a counter-motion, and being met by rays of almost prismatic colours in the shape of a V, completing the semi-circle;

at other times with upright pencilled rays, until they appear again to shoot to and fro, and gradually disappear in the southern sky. Streamers, too, frequently shoot, as he has described them, from perhaps an altitude of 50 to 60 degrees, more or less, and are visible in various places almost at the same moment of time. They vanish at their northern faces, and reappear afresh at their southern, being again projected downwards until they disappear in the southern horizon; lost to sight for a brief interval, and bursting instantaneously into view; once more drooping and expiring when the southern fringe had reached 30 degrees south of the zenith. I have seen at Fort Reliance, two years in succession, many such appearances; but on one particular occasion the sky was generally diffused with the aurora, which quickly separated into arches, beams, and rays, and darted to and from the opposite horizons; then as suddenly opened up into bands or curves. It speedily rushed across the zenith, nearly to the opposite horizon; became broken up in different forms; darted upwards anew and formed near the zenith a beautiful corona borealis; then, dispersing in an instant of time, it formed itself into six distinct figures, representing the letter S, and moved with incredible velocity, thus presenting the strange appearance of so many huge snakes whirling and twisting in every direction, until exhausted, as it were, by excess of motion, the beautiful phenomenon again receded and dissolved in the south, leaving in the spectator a sense of extreme loneliness, almost painful. As for the colours of the aurora, they appear nearly, as Mr. Tayler has stated, from steel grey to pale yellow, orange, red, &c., varying in lustre according to circumstances. The aurora is seldom seen at a lower angle than 4 degrees from the horizon. I may say, in the first instance, that there are two motions, the direct and the lateral. The direct motion of the aurora is usually in a plane, seldom varying more than 22 degrees from the magnetic meridian; while the lateral motion is at right angles to the magnetic meridian. Thus, an arch of the aurora will sometimes move from the zenith 60 or 70 degrees towards the southern horizon, whilst its extremities east and west remain nearly stationary. Beams and flashes, contrary to the others, are generally inclined in the direction of the dipping needle. Near the magnetic meridian they assume a position perpendicular to the horizon; but at some distance east and west they decline towards the perpendicular, at different angles, having occasionally a small deviation of parallelism among themselves. I think Mr. Tayler says that the aurora, according to his observation, is not a luminous or electric vapour reaching to the earth. It is true that in seven winters I never saw the common cork-ball electrometer charged; but with a more delicate instrument—more susceptible—I have seen it drawn away 25 minutes, and afterwards to upwards of 30 degrees. As regards magnetism, which is always interesting, I may mention, that Professor Christie, who was then Secretary of the Royal Society, had a needle 8½ inches in length made expressly for me. It was suspended so delicately that the slightest cause of disturbance affected it. This needle was frequently disturbed by the aurora. On one occasion it was deflected to 7° 50', consequently nearly to 8° on one side of its zero, at a temperature of 20° minus zero. The arc of the instrument was only graduated to 10°, thus putting at rest for ever the question of the aurora affecting the needle. I may also mention in connexion with the same instrument, that when the arches have been urged with a counter-motion from one horizon to another, across the magnetic meridian, the needle has vibrated to and fro, east and west of its zero, and then again suddenly stopped; and at one time actually dipped at one end of the needle 8 minutes. As to the height of the aurora there are various opinions. One philosopher thought it to be 800 miles high. Another, Mr. Dalton, considered it to be 100 miles; but that was deemed to be erroneous. In our more recent journeys and voyages to the northern regions, it was the general opinion, founded on observation, that

the aurora varied between a height of two to four miles, but very frequently much lower, as described by Mr. Tayler. Indeed, it was very common to see the lower surface of nebulous clouds illuminated by polar light, thus showing its proximity to the earth. I remember Sir Edward Parry, when in a different latitude observing the aurora, saw a bright ray shoot suddenly down between him and the land, distant at that time only 3000 yards. I have frequently seen it nearly—that is to say, apparently—touching the tops of the pine-trees, situated on a slight elevation, about a mile and a half from my observatory. And I may take this opportunity of mentioning, for it will not be devoid of interest to some in this meeting connected with the old North-West Company, now the Hudson Bay Company, that as Mr. Clark, one of its officers, was passing over a portage of the river *Maligne*, the coruscations of the aurora were so low and vivid that the Canadian voyageurs threw from them their knives, axes, or whatever metallic things they were carrying, and actually fell with their faces to the earth. Lastly, I would remark, that many have thought—old travellers especially—that there was a noise caused by the aurora resembling the rustling of a flag in a strong breeze. We almost thought so too, I mean Franklin, Richardson, and myself, for a long time; but we discovered that it was simply the effect of severe cold after a comparatively warm day; that is to say, when the snow had been thawed during the day, and a cold of 30 to 42 degrees minus zero had succeeded at night. On those occasions we heard a hissing sound, and when the aurora was in rapid motion, it was natural to associate that motion with the sound. However, that was not the case. Nevertheless, the Indians and many of the old residents in the Hudson Bay Company's territories are of unanimous opinion that its motions are sometimes audible.

The PRESIDENT.—Sir George Back has left very little more to be said respecting this remarkable phenomenon. I am happy, however, to see near me Admiral van Dockum, the Minister of Denmark, that power to which Greenland belongs; the country in which Mr. Tayler made his observations. It gives me pleasure to remind you that the Danish Captain Graah, a distinguished maritime explorer, has admirably described the phenomena of the aurora borealis in a work which has been translated into English at the expense of this Society.*

The second Paper read was—

2. *Discovery by Captain JOHN PALLISER, F.R.G.S., and Dr. HECTOR, of Practicable Passes through the Rocky Mountains within the British Possessions.*

Communicated by the Right Hon. Sir E. BULWER LYTTON, Bart., M.P.,
Her Majesty's Secretary of State for the Colonies.

CAPTAIN PALLISER's despatch is dated from Fort Edmonton, his winter quarters on the Saskatchewan river, and narrates the proceedings of himself and his party about the east flanks of the Rocky Mountains and the upper course and tributaries of that river during the previous summer.

The chief results before us lie in the discovery and mapping of the following numerous passes:—

* See Graah's Greenland. J. W. Parker, Strand, 1837.—Ed.